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# POST - MORTEM I N S P E C T I O N of Swine

E. Ciolfi, D.V.M.

An Effectiveness and Productivity Study

October 1988

Slaughter Inspection Standards and Procedures Division  
Technical Services

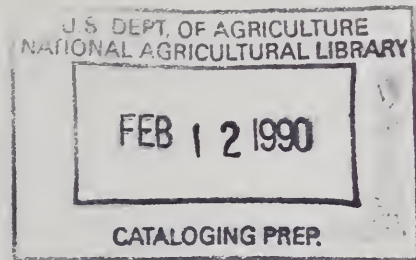
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# Post-Mortem Inspection of Swine

E. Cioffi, D.V.M.

An Effectiveness and Productivity Study



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## SUMMARY

The Slaughter Inspection Standards and Procedures (SISP) Division conducted a study on two new swine post-mortem inspection procedures and the procedure currently used by the U.S. Department of Agriculture (USDA) between March 8, 1987, and September 2, 1988.

The study assessed and compared the effectiveness and productivity of the new and current procedures in six plants: three market hog plants, where the viscera/carcass inspection tasks had been combined as a result of a previous study, "A New Approach to Swine Post-Mortem Inspection", and in one sow/boar plant and two market hog plants, where such tasks were performed separately.

During the comparison study, the inspection responsibilities and line speeds were not changed. The inspectors, regularly assigned to post-mortem inspection, performed the inspection procedures and veterinary medical officer evaluators performed the required evaluations. The evaluators randomly selected and evaluated 36,000 sets of viscera (units) and 12,000 carcasses. A total of 48,000 units were evaluated during the study.



The results of the effectiveness and productivity evaluations revealed that the new procedures were as effective as and more productive than the current procedure. As the current procedure, they achieved the same inspection quality and assured the same consumer protection. In addition, Procedure No. 1 proved to be more productive than the other procedures by reducing the time to complete inspection and inspectors' fatigue; therefore, it is recommended that USDA implement this inspection procedure in all swine slaughter plants in the United States.

## INTRODUCTION

Recent feasibility studies, conducted by the Slaughter Inspection Standards and Procedures (SISP) Division, indicated that steps of the current viscera inspection procedure could be modified or eliminated without affecting the detection of diseases and abnormalities, the wholesomeness of the product, and the effectiveness of consumer protection. SISP conducted an extensive study between March 8, 1987, and September 2, 1988. This study involved six plants: three market hog plants, where the viscera and carcass inspection tasks had been combined on a pilot basis as a result of a previous study, "A New Approach to Swine Post-Mortem Inspection," and one sow/boar plant and two market hog plants, where these tasks were performed separately.

During this study, the head and carcass inspection procedures were not changed in the three plants where the viscera/carcass tasks had been combined; therefore, only the viscera inspection procedures were evaluated. In the other three plants, because the viscera and carcass procedures were changed, the study included evaluations of the current and new viscera and carcass inspection procedures. After the effectiveness tests were completed, the Inplant Testing Staff and the Industrial Engineering and Data Management (IEDM) Division collected work measurement data.



Upon completion of the inplant studies, IEDM performed a preliminary workload analysis, the Mathematics and Statistics (MS) Division summarized the effectiveness data and performed a statistical analysis, and the Planning and Evaluation Staff evaluated all data and made the necessary recommendations.

## OBJECTIVE

The objectives of the study were to:

- o Identify new inspection procedures.
- o Select and evaluate the most feasible, effective and productive inspection procedures.
- o Compare the effectiveness and productivity of current and new inspection procedures.

In all six plants, the head inspection procedure was not changed. Because a previous study already included evaluations of the carcass inspection procedure in the three plants operating as pilot plants with combined viscera/carcass stations, the carcass inspection procedure was only changed in the three plants operating with the current procedure. The study objectives, therefore, were to determine the effectiveness and productivity of new and current viscera inspection procedures in all six plants, and of new and current carcass inspection procedures in the three plants operating with the current procedure.

The study tested the hypothesis that the new inspection procedures are as effective as and more productive than the current procedure. As the current procedure, they should detect the same diseases and abnormalities, achieve the same inspection

quality, and assure the same consumer protection. In addition, they should reduce the time required to complete inspection, decrease inspectors' fatigue, and make inspectors' work easier.

## BACKGROUND

### USDA Responsibility

The Federal Meat and Poultry Inspection Acts require that inspectors perform ante-mortem and post-mortem inspection of livestock and poultry. The primary purpose of post-mortem inspection is to detect signs of diseases and other abnormal conditions that may render carcasses, or some of their organs, unfit for human food. Carcasses or organs determined to be unwholesome are condemned and properly disposed of under inspector's supervision.

USDA has many responsibilities. One of them is to maintain, design, and develop the most effective and productive methods of inspecting animals at slaughter. To accomplish this, special studies are routinely conducted by SISP to evaluate the existing inspection systems, to design and develop new systems, and to determine and compare the effectiveness and productivity of existing and new systems. During these studies, thousands of carcasses and organs are inspected by trained inspectors and are then carefully evaluated by veterinary medical officers.

Post-mortem inspection requires a large portion of USDA's budget. Therefore, USDA's ongoing responsibility for productive utilization of its resources is especially important with respect

to post-mortem inspection. A failure to use the most productive inspection procedures could result in costs to the American consumers which would be significantly higher than necessary.

#### Routine Inspection

Routine post-mortem inspection of swine (Table 1) is divided into three phases: head inspection, viscera inspection, and carcass inspection. During each phase, inspectors perform specific tasks, which involve a sequence of observing, palpating, and incising certain tissues and lymph nodes. These tasks, performed at three inspection stations, have proved to be an effective and productive method of inspection. However, recent studies conducted by SISP show that, by combining and performing the carcass and viscera inspection tasks at the viscera inspection station, inspection productivity improves without affecting the quality or wholesomeness of the product.

When carcasses are affected by a disease or abnormality, such carcasses are retained for "final" examination by veterinary medical officers who, depending upon the disease or abnormality, perform thorough and expanded examinations by observing, palpating, and incising tissues and lymph nodes.



Table 1 -- Current Swine Post-Mortem Inspection 1/

Inspection Station	Step	Procedure
Head	1.	Observe head and cut surfaces
	2.	Incise and observe mandibular lymph nodes
	3.	Observe/retain carcass when required
-----		
Viscera	1.	Observe eviscerated carcass, viscera, and parietal (top) surface of spleen
	2.	Observe and palpate mesenteric lymph nodes
	3.	Palpate portal lymph nodes
	4.	Observe dorsal surfaces of lungs
	5.	Palpate bronchial lymph nodes
	6.	Observe mediastinal lymph nodes
	7.	Turn lungs over and observe ventral surfaces
	8.	Observe heart
	9.	Observe dorsal surface of liver
	10.	Turn liver over and observe ventral surface
	11.	Condemn viscera or parts when required
	12.	Retain carcass, viscera, and parts when required
-----		
Carcass	1.	Look in mirror and observe back of carcass
	2.	Observe front parts and inside of carcass
	3.	Grasp, turn, and observe kidneys (both sides)
	4.	Direct trim, remove retain tags, or retain carcass when required

1/ Inspectors must examine carcasses, organs, and parts for diseases, abnormalities, cleanliness.

## Number of Inspectors

In general, the number of inspectors assigned to swine post-mortem inspection at a plant is related to the size of the plant and the speed of operation. In small plants with a slow slaughter rate, one inspector may complete all inspection procedures at one station; in larger plants with faster line speeds, two or more inspectors complete the inspection procedures at two or three stations--head and viscera/carcass, or head, viscera, and carcass stations.

At three of the test plants, routine post-mortem inspection was carried out at two stations; at the other three plants, it was completed at three stations.

During inspection of the heads, viscera, and carcasses, the inspectors examine each head, organ, and carcass to determine whether they are fit for human food. It is during all phases of inspection that the heads, organs, and carcasses can be examined easily, if they are properly presented for inspection.



## METHODOLOGY

### Designation of Experts

Scientific and technical experts from various Agency programs and areas of the United States were designated and formed a study team. This team was divided into planning and evaluation staff and inplant testing staff. The first group designed and developed the necessary tasks to evaluate the current and new inspection procedures, and evaluated and analyzed the data collected during the study. The second group conducted the inplant evaluations and collected all necessary data.

### Plant Selection and Type

Plant selection was based on several factors, including adequate facilities, equipment, and space to conduct the necessary evaluations; line speed and daily slaughter volume sufficient to evaluate the required number of units; disease incidence in animals slaughtered; location; and plant management attitude.

From all swine slaughter plants operating under Federal inspection, a group of 25 was identified. This group was subsequently reduced to 10 which, after examining their blueprints, were visited and reviewed by the project manager to determine their feasibility for conducting the necessary

evaluations. Six of the 10 plants reviewed were finally selected. These included three plants operating as pilot with current and combined viscera/carcass procedures.

Each selected plant was identified with a number from 1 to 6 -- No. 1, No. 2, No. 3, No. 4, No. 5, and No. 6--depending upon where the evaluations were done first, second, etc.

The study was conducted at the following type of plants:

Plant No.	Type of Animals	Line Speed/Hr.
1	Market Hogs	790
2	Market Hogs	400
3	Market Hogs	900
4	Sows/Boars	360
5	Market Hogs	1055
6	Market Hogs	780

#### Presentation Methods

The methods of presenting the heads and carcasses for inspection were not changed during the study. However, some viscera presentation changes were necessary to evaluate the new procedures.

With the current procedure, the abdominal and thoracic viscera from each swine carcass were removed, together and intact, and

placed in a pan so that the inspectors need not perform additional motions to inspect them. This is the traditional and most common method of viscera presentation, which seems to be very productive especially in large slaughter operations.

To perform the new procedures, the eviscerator first removed and placed the abdominal and thoracic viscera in a pan; then, for Procedure No. 1, he placed the heart under the lungs' right apical lobe and moved the lungs away from the liver to expose the liver's dorsal surface. For Procedure No. 2, a plant employee separated the heart from the lungs, placed the heart in the pan, and moved the lungs away from the liver.

#### Presentation/Procedure Relation

When plant employees used the traditional method of presentation, the inspectors performed the current procedure or the current procedure with combined viscera/carcass tasks. When they used the modified methods, the inspectors performed the new procedures.

#### Head/Carcass Inspection

The steps of the current head inspection procedure (Table 1) were not affected by the new procedures; nor were affected those of the carcass inspection procedure where the viscera/carcass inspection tasks had been combined (Table 2); therefore, they were not changed during the study.

## Viscera Inspection

Current procedure. The current procedure (Table 1) was performed at the three plants operating with three inspection stations. The current procedure with combined viscera/carcass tasks (Table 2) was performed at the three plants operating with two stations. These procedures require the inspectors to observe the eviscerated carcasses for disease conditions and dressing errors, and to observe and/or palpate various abdominal and thoracic structures, including the liver, spleen, lungs, heart, stomach, intestine, and lymph nodes. Other duties of the viscera inspectors include retaining carcasses for veterinary disposition and marking condemned viscera or parts.

New procedures. The new procedures (Tables 3, 4, 5 and 6) were done in combination with the modified presentation methods, were tested and compared with the current procedure, and required the inspectors to perform duties similar to those performed with the current procedure.

## Carcass Inspection

The carcass inspection procedure performed at the two-inspection-station plants was not evaluated during this study, because it was evaluated during a previous study. Therefore, the current procedure (Table 1) and the new procedures (Tables 5 and 6) were evaluated only at the plants with three inspection stations.



Table 2 - Current Procedure with Combined Viscera/Carcass Tasks 1/

HEAD INSPECTION

1. Observe
  - Head and cut surfaces
  - Back of carcass up to ham area
2. Incise and observe mandibular lymph nodes
3. When necessary
  - Observe/retain carcass
  - Attach alert tag
  - Condemn head

VISCERA/CARCASS INSPECTION

1. Look in mirror and observe ham area of carcass. Observe entire carcass when identified with alert/retain tag
2. Observe
  - Front of carcass, interior, kidneys, limbs
  - Viscera including top surface of spleen
3. Observe and palpate mesenteric lymph nodes
4. Palpate portal lymph nodes
5. Observe dorsal surfaces of lungs
6. Palpate bronchial lymph nodes
7. Observe mediastinal lymph nodes
8. Turn lungs over and observe ventral surfaces
9. Observe
  - Heart
  - Dorsal surface of liver
10. Turn liver over and observe ventral surface
11. When necessary
  - Condemn viscera and parts
  - Direct trim, kidney removal, attachment of alert or retain tags
  - Grasp, turn and observe kidneys (placed in pan)

---

1/ Inspectors must examine carcasses, organs, and parts for diseases, abnormalities, cleanliness.

Table 3 - Procedure No.1 with Combined Viscera/Carcass Tasks 1/

HEAD INSPECTION

1. Observe head and cut surfaces
2. Incise and observe mandibular lymph nodes
3. When necessary
  - Observe/retain carcass
  - Attach alert tag
  - Condemn head

VISCERA/CARCASS INSPECTION

1. Observe carcass
  - Back leading side in mirror
  - Front, interior, kidneys, limbs
2. Observe viscera including
  - Top surface of spleen
  - Dorsal surfaces of lungs
  - Mediastinal lymph nodes
3. Observe and palpate mesenteric lymph nodes
4. Grasp and observe heart
5. Observe
  - Dorsal surface of liver
  - Carcass back trailing side in mirror
6. When necessary
  - Turn lungs and observe ventral surfaces
  - Turn liver and observe ventral surface and portal lymph nodes
  - Condemn viscera and parts
  - Direct trim, kidney removal, attachment of alert/retain tags
  - Grasp, turn and observe kidneys(placed in pan)

---

1/ Inspectors must examine carcasses, organs and parts for diseases, abnormalities, cleanliness.

Table 4 - Procedure No. 2 with Combined Viscera/Carcass Tasks 1/

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HEAD INSPECTION

1. Observe head and cut surfaces
2. Incise and observe mandibular lymph nodes
3. When necessary
  - Observe/retain carcass
  - Attach alert tag
  - Condemn head

VISCERA/CARCASS INSPECTION

1. Observe carcass
  - Back leading side in mirror
  - Front, interior, kidneys, limbs
2. Observe viscera including
  - Top surface of spleen
  - Dorsal surfaces of lungs
  - Mediastinal lymph nodes
  - Dorsal surface of liver
  - Heart
3. Observe and palpate mesenteric lymph nodes
4. Observe carcass back trailing side in mirror
5. When necessary
  - Grasp and observe heart
  - Move right lung to observe liver's dorsal surface
  - Turn lungs and observe ventral surfaces
  - Turn liver and observe ventral surface and portal lymph nodes
  - Condemn viscera and parts
  - Direct trim, kidney removal, attachment of alert/retain tags
  - Grasp, turn and observe kidneys(placed in pan)

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1/ Inspectors must examine carcasses, organs and parts for diseases, abnormalities, cleanliness.



Table 5 - Procedure No.1 with Three-Inspection Station Tasks 1/

HEAD INSPECTION

1. Observe head and cut surfaces
2. Incise and observe mandibular lymph nodes
3. When necessary
  - Observe/retain carcass
  - Condemn head

VISCERA INSPECTION

1. Observe eviscerated carcass
2. Observe viscera including
  - Top surface of spleen
  - Dorsal surfaces of lungs
  - Mediastinal lymph nodes
3. Observe and palpate mesenteric lymph nodes
4. Grasp and observe heart
5. Observe dorsal surface of liver
6. When necessary
  - Turn lungs and observe ventral surfaces
  - Turn liver and observe ventral surface and portal lymph nodes
  - Condemn viscera and parts
  - Retain carcass, viscera and parts

CARCASS INSPECTION

1. Observe carcass
  - Back leading side in mirror
  - Front, interior, kidneys, limbs
  - Back trailing side in mirror
2. When necessary
  - Direct trim
  - Remove retain tags or retain carcass
  - Grasp, turn and observe kidneys

---

1/ Inspectors must examine carcasses, organs and parts for diseases, abnormalities, cleanliness.

Table 6 - Procedure No.2 with Three-Inspection Station Tasks 1/

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HEAD INSPECTION

1. Observe head and cut surfaces
2. Incise and observe mandibular lymph nodes
3. When necessary
  - Observe/retain carcass
  - Condemn head

VISCERA INSPECTION

1. Observe eviscerated carcass
2. Observe viscera including
  - Top surface of spleen
  - Dorsal surfaces of lungs
  - Mediastinal lymph nodes
  - Dorsal surface of liver
  - Heart
3. Observe and palpate mesenteric lymph nodes
4. When necessary
  - Grasp and observe heart
  - Move right lung to observe liver's dorsal surface
  - Turn lungs and observe ventral surface and portal lymph nodes
  - Condemn viscera and parts
  - Retain carcass, viscera and parts

CARCASS INSPECTION

1. Observe carcass
  - Back leading side in mirror
  - Front, interior, kidneys, limbs
  - Back trailing side in mirror
2. When necessary
  - Direct trim
  - Remove retain tags or retain carcass
  - Grasp, turn and observe kidneys

---

1/ Inspectors must examine carcasses, organs and parts for diseases, abnormalities, cleanliness.

The current procedure requires the inspector to observe the carcass; grasp, turn, and observe the kidneys; and direct trim, remove retain tags, or retain the carcass when necessary. The new procedure is similar, except that the routine grasping, turning, and observing all kidneys are replaced by observing only, and by grasping, turning, and observing them when necessary.

#### Difference in Procedures

The difference between the current and new procedures is summarized in Tables 7 through 10.

#### Training

Before testing, training of plant and inspection personnel was necessary. Therefore, the project manager and a member of the Program Training Division visited the test plants before the implant evaluation. During the visit, they conducted on-the-job training meetings and trained involved plant employees to perform the proper presentation methods; then, they trained the veterinary inspector in charge and the inspectors assigned to post-mortem inspection to perform the new inspection procedures. Training continued until the plant employees did the presentation methods properly and each inspector was confident in performing the new inspection procedures.

Table 7 - Procedure Difference; Head Inspection

Head Carcass Other	Procedure					
	Current (Table 1)	Procedure No.1 (Table 5)	Procedure No.2 (Table 6)	Current Viscera/Carcass (Table 2)	Procedure No.1 Viscera/Carcass (Table 3)	Procedure No.2 Viscera/Carcass (Table 4)
Head	Observe	Observe	Observe	Observe	Observe	Observe
	Condemn when necessary	Condemn when necessary	Condemn when necessary	Condemn when necessary	Condemn when necessary	Condemn when necessary
Cut surfaces	Observe	Observe	Observe	Observe	Observe	Observe
Mandibular lymph nodes	Incise, observe	Incise, observe	Incise, observe	Incise, observe	Incise, observe	Incise, observe
Carcass when necessary	Observe, retain	Observe, retain	Observe, retain	Observe, retain	Observe, retain	Observe, retain
Carcass back up to ham area	-	-	-	Observe	-	-
Alert tag	-	-	-	Attach when necessary	Attach when necessary	Attach when necessary

Table 8 - Procedure Difference; Viscera Inspection

Carcass, Organ, Other	Procedure		
	Current (Table 1)	Procedure No.1 (Table 5)	Procedure No.2 (Table 6)
Eviscerated carcass	Observe	Observe	Observe
Viscera	Observe	Observe	Observe
Spleen top surface	Observe	Observe	Observe
Mesenteric lymph nodes	Observe, palpate	Observe, palpate	Observe, palpate
Portal lymph nodes	Palpate	Observe when necessary	Observe when necessary
Lungs			
Turn	Routinely	When necessary	When necessary
Dorsal surfaces	Observe	Observe	Observe
Ventral surfaces	Observe	Observe when necessary	Observe when necessary
Bronchial lymph nodes	Palpate	-	-
Mediastinal lymph nodes	Observe	Observe	Observe
Heart	Observe	Grasp, observe	Observe. Grasp, observe when necessary
Liver			
Turn	Routinely	When necessary	When necessary
Dorsal surface	Observe	Observe	Observe
Ventral surface	Observe	Observe when necessary	Observe when necessary
Viscera, parts			
Condemn/retain	When necessary	When necessary	When necessary
Carcass			
Retain	When necessary	When necessary	When necessary



Table 9 - Procedure Difference; Carcass Inspection

Carcass, Organ, Other	Procedure		
	Current (Table 1)	Procedure No.1 (Table 5)	Procedure No.2 (Table 6)
Carcass			
Back(in mirror)	Observe	Observe	Observe
Front	Observe	Observe	Observe
Inside	Observe	Observe	Observe
-----			
Kidneys	Grasp, turn, observe	Grasp, turn, observe when necessary	Grasp, turn, observe when necessary
-----			
Direct trim	When necessary	When necessary	When necessary
-----			
Retain tag			
Attach	When necessary	When necessary	When necessary
Remove	When necessary	When necessary	When necessary

Table 10 - Procedure Difference; Viscera/Carcass Inspection

Carcass, Organ, Other	Procedure		
	Current Viscera/Carcass (Table 2)	Procedure No.1 Viscera/Carcass (Table 3)	Procedure No.2 Viscera/Carcass (Table 4)
Carcass ham area (in mirror)	Observe	-	-
Entire carcass (in mirror)	Observe when alert/retain tag	Observe	Observe
Carcass front, interior, kidneys, limbs	Observe	Observe	Observe
Viscera	Observe	Observe	Observe
Spleen top surface	Observe	Observe	Observe
Mesenteric lymph nodes	Observe, palpate	Observe, palpate	Observe, palpate
Portal lymph nodes	Palpate	Observe when necessary	Observe when necessary
Lungs			
Turn	Routinely	When necessary	When necessary
Dorsal surfaces	Observe	Observe	Observe
Ventral surfaces	Observe	Observe when necessary	Observe when necessary
Bronchial lymph nodes	Palpate	-	-
Mediastinal lymph nodes	Observe	Observe	Observe
Heart	Observe	Observe	Observe
Liver			
Turn	Routinely	When necessary	When necessary
Dorsal surface	Observe	Observe	Observe
Ventral surface	Observe	Observe when necessary	Observe when necessary
Viscera, parts			
Condemn/retain	When necessary	When necessary	When necessary
Direct trim	When necessary	When necessary	When necessary
Direct kidney removal	When necessary	When necessary	When necessary
Kidneys (placed in pan)	Grasp, turn, observe when necessary	Grasp, turn, observe when necessary	Grasp, turn, observe when necessary
Alert tag			
Direct attachment	When necessary	When necessary	When necessary
Retain tag			
Direct attachment	When necessary	When necessary	When necessary



## Evaluation

Evaluation sites and evaluators. To evaluate and compare the effectiveness of the current and new inspection procedures, one evaluation site was used at the three plants where the viscera/carcass inspection tasks had been combined and two sites were used at the other plants. The sites were next to or down the line from the inspection stations.

At the viscera evaluation sites, because of different facility layouts and line speeds, three or four veterinary medical officers evaluated the current and new procedures: In two plants, three evaluators--one evaluator, one evaluator/recorder and one evaluator/backup; in one plant, four evaluators--two evaluators, one evaluator/recorder and one evaluator/backup; and in three plants, four evaluators--one evaluator, two evaluator/recorders and one evaluator/backup. The evaluators examined the units, recorded on worksheets any lesions or errors missed by the inspectors, and assured that all units inspected with the new procedures met the standards of wholesomeness.

At the carcass evaluation sites, two veterinary medical officer evaluators--one evaluator and one evaluator/recorder--performed the same tasks on units inspected with the current and new procedures.

Selection of evaluations. Before the beginning of the first evaluation and thereafter each day, the project manager wrote on separate pieces of paper the abbreviation codes of the viscera inspection procedures (current, Procedure No. 1, Procedure No. 2) and of the carcass inspection procedures (current, new) to be evaluated. He folded those pieces of paper and randomly selected them to determine which procedure should be done first, second, etc. This selection was unknown to the evaluators. The remaining evaluations were alternated during the day. For example: If the current viscera procedure was evaluated first; if Procedure No. 1 was evaluated second; and if Procedure No. 2 was evaluated third; then, the current procedure was evaluated fourth, or the second time during the day. Similarly, if the current carcass procedure was evaluated first; and the new carcass procedure was evaluated second; then, the current procedure was evaluated third; or the second time during the day.

Evaluator and inspector assignments. Each day, before the beginning of the first evaluation, the project manager wrote the abbreviation codes of the veterinary medical officer assignments on separate pieces of paper, folded those pieces of paper and randomly selected them to determine who would serve first as evaluator, evaluator/recorder, and evaluator/backup.

During each evaluation, testing of the sampled units was accomplished by following a rotational system. The inspectors performing the different procedures and the veterinary medical officer evaluators were instructed by the project manager when and how to rotate. This gave an opportunity to the inspectors to perform and to the veterinary medical officer evaluators to evaluate all procedures.

Pilot test. After training, when plant employees were able to do the methods of presentation properly and the inspectors were confident in performing the appropriate procedures correctly, a pilot test began. This test was designed to allow plant employees, inspectors, and evaluators to become familiar with the testing process, and to allow the project manager to make any adjustments before the actual test began. During the pilot test, data were collected and reviewed, but were not included in the study.

Presentation and procedure review. During the pilot test and before the beginning of each evaluation, the project manager reviewed the methods of presenting the units for inspection and instructed designated plant representatives to make any adjustments, if necessary. Then, he instructed the inspectors to perform the designated procedure. He delayed the beginning of the evaluation until he reviewed and determined that all units



were properly presented for inspection and the inspectors performed the appropriate procedure correctly.

Procedure of evaluation. The inspection procedures were performed by the inspectors regularly assigned to the test plants. The evaluation procedures were performed by veterinary medical officers.

Upon completion of the pilot test, the actual test began. After the units were inspected by the inspectors, they were closely examined on the line by the evaluators, who were located next to or down the line from the inspection stations. While the evaluators examined the units, an evaluator/recorder evaluated the tasks, observed the units, and recorded any disease and abnormality detected during the evaluation. Also, when diseases or abnormalities were detected, the inspectors and evaluators took the necessary actions as required by regulations.

Backup inspection. To assure that products inspected by the new procedures met the standards for wholesomeness, all units subjected to these procedures during testing received an additional inspection, which provided the steps of the current procedure that were omitted. This "backup" inspection was performed at or down the line from the evaluation sites.

Tasks of viscera evaluation. The tasks of viscera evaluation at the two - inspection stations were:

A. Current Procedure

1. Plant employee removed abdominal and thoracic viscera from carcass and placed them in pan.

2. Inspector performed viscera/carcass procedure (Table 2).

3. Evaluator evaluated every other set of viscera.

4. Evaluator/recorder observed and recorded diseases/adnormalities on worksheets.

5. Evaluator/backup observed all viscera and performed current procedure on those not evaluated.

B. Procedure No. 1

1. Plant employee:

a. Removed abdominal and thoracic viscera from carcass and placed them in pan.

b. Moved and placed heart under right apical lobe.

2. Inspector performed viscera/carcass Procedure No. 1 (Table 3).

3. Evaluator evaluated every other set of viscera.

4. Evaluator/recorder observed and recorded diseases/abnormalities on worksheets.



5. Evaluator/backup observed all viscera and performed current procedure on those not evaluated.

C. Procedure No. 2

1. Plant employee:

a. Removed abdominal and thoracic viscera from carcass and placed them in pan.

b. Separated heart from lungs, placed heart in pan, and moved lungs away from liver.

2. Inspector performed viscera/carcass Procedure No. 2 (Table 4).

3. Evaluator evaluated every other set of viscera.

4. Evaluator/recorder observed and recorded diseases/abnormalities on worksheets.

5. Evaluator/backup observed all viscera and performed current procedure on those not evaluated.

The tasks of viscera evaluation at the three - inspection stations were:

A. Current Procedure

1. Plant employee removed abdominal and thoracic viscera from carcass and placed them in pan.

2. Inspector performed viscera procedure (Table 1).

3. Evaluator evaluated every other set of viscera.

4. Evaluator/recorder observed and recorded diseases/abnormalities on worksheets.

5. Evaluator/backup observed all viscera and performed current procedure on those not evaluated.

B. Procedure No. 1

1. Plant employee:

a. Removed abdominal and thoracic viscera from carcass and placed them in pan.

b. Moved and placed heart under right apical lobe.

2. Inspector performed viscera Procedure No. 1 (Table 5).

3. Evaluator evaluated every other set of viscera.

4. Evaluator/recorder observed and recorded diseases/abnormalities on worksheets.

5. Evaluator/backup observed all viscera and performed current procedure on those not evaluated.

C. Procedure No. 2

1. Plant employee:

a. Removed abdominal and thoracic viscera from carcass and placed them in pan.

b. Separated heart from lungs, placed heart in pan, and moved lungs away from liver.

2. Inspector performed viscera procedure No. 2 (Table 6).
3. Evaluator evaluated every other set of viscera.
4. Evaluator/recorder observed and recorded diseases/abnormalities on worksheets.
5. Evaluator/backup observed all viscera and performed current procedure on those not evaluated.

Tasks of Carcass Evaluation. The tasks of carcass evaluation were as follows:

A. Current Procedure

1. Plant employee presented all carcasses for inspection as required.
2. Inspector performed current carcass procedure (Table 1).
3. Evaluator evaluated (only) the kidneys.
4. Evaluator/recorder observed and recorded diseases/abnormalities on worksheets.

B. New Procedure

1. Plant employee presented all carcasses for inspection as required.
2. Inspector performed new carcass procedure (Tables 5 and 6).

3. Evaluator evaluated (only) the kidneys.

4. Evaluator/recorder observed and recorded diseases/abnormalities on worksheets.

### Sampling

Selection of units. At the viscera evaluation site, one unit consisted of a complete set of viscera, whether it was presented for inspection intact or with the heart removed. At the carcass evaluation site, one unit consisted of both kidneys; however, if one kidney was missing, the one present was considered as one unit.

Upon completion of the pilot test, the actual test began. The evaluators randomly selected 100 units as follows: when instructed by the project manager, they selected a unit as it went by on the line. This unit was not to be examined, but to be used as a starting point. The evaluators, then, selected the sixth unit (following this starting point) as the first one to be evaluated. This procedure was done at the beginning of each evaluation. The evaluators examined the unit and recorded any disease and abnormality detected on worksheets.

When the evaluators completed the first unit, they selected the next one as it became available, examined it, and had the results recorded. The remaining units were selected (examined and



results recorded) as they became available until 100 were examined and the results recorded.

In addition to serving as an observer and recorder, the evaluator/recorder occasionally was asked by the evaluators to examine questionable lesions so that an accurate diagnosis could be made. The evaluators also had the option of retaining the units, when necessary, for closer examination.

Number of units. Each day for approximately 7 days, the evaluators randomly selected and evaluated, at the viscera evaluation site, about 900 units--300 inspected with current procedure; 300 inspected with Procedure No. 1; and 300 inspected with Procedure No. 2. At the carcass evaluation site, they selected and evaluated about 600 units--300 inspected with current procedure and 300 inspected with new procedure. At the viscera evaluation sites, 36,000 units were evaluated; at the carcass evaluation sites, 12,000 units. A total of 48,000 units were evaluated during the study.

Effectiveness data; worksheets. Following the instructions in Appendix A, the evaluation results were recorded on worksheets (Appendix B). The evaluators examined the units, as instructed, for diseases and abnormalities. Each unit examined and each lesion or error missed by the inspectors were tallied and recorded on worksheets.



Review of worksheets. Upon completion of each worksheet, the project manager reviewed all entries and initialed in the appropriate space. Then, he instructed the designated plant representative(s) to make the appropriate presentation changes for the next procedure to be evaluated. He delayed the evaluation until plant employees, inspectors, and evaluators adjusted to the different methods of presentation and inspection.

Work measurement data. During the study, work measurement data were also collected. These data included video taping the inspectors while performing the new procedures and the recording of any other data involved, such as washing hands, condemning viscera or parts, retaining carcasses.

## RESULTS

### Summary of Results

All data collected during the inplant evaluations were reviewed and analyzed. The results are summarized in Table 11, Summary of Viscera Evaluation Results by plant; Table 12, Summary of Viscera Evaluation Results by Procedure; Table 13, Summary of Carcass Evaluation Results by Plant; and Table 14, Summary of Carcass Evaluation Results by Procedure.

Table 11 - Summary of Viscera Evaluation Results by Plant

Plant No.	Current Procedure <u>1/</u>		Procedure No.1 <u>1/</u>		Procedure No.2 <u>1/</u>	
	Units Free of Errors	Percent Accuracy	Units Free of Errors	Percent Accuracy	Units Free of Errors	Percent Accuracy
1	1955	97.8	1965	98.3	1950	97.5
2	1972	98.6	1979	99.0	1968	98.4
3	1986	99.3	1990	99.5	1985	99.3
4	1948	97.4	1958	97.9	1958	97.9
5	1946	97.3	1953	97.7	1944	97.2
6	1984	99.2	1984	99.2	1979	99.0

1/ Units evaluated for each procedure: 2,000

Table 12 - Summary of Viscera Evaluation Results by Procedure

Inspection Procedure <u>1</u> /	Type of Error	Units Free of Errors		
		Total	Percent	CI 95% <u>2</u> /
Current	Pathological	11848	98.7	98.5-98.9
	Dressing	11943	99.5	99.4-99.6
	Total	11791	98.3	98.1-98.5
-----				
No. 1	Pathological	11879	99.0	98.8-99.2
	Dressing	11947	99.6	99.5-99.7
	Total	11829	98.6	98.4-98.8
-----				
No. 2	Pathological	11848	98.7	98.5-98.9
	Dressing	11935	99.5	99.4-99.6
	Total	11784	98.2	98.0-98.4

1/ Units evaluated for each procedure: 12,0002/ Confidence interval: 95 percent

Table 13 - Summary of Carcass Evaluation Results by Plant

Plant No.	Current Procedure <u>1</u> /		New Procedure <u>1</u> /	
	Units Free of Errors	Percent Accuracy	Units Free of Errors	Percent Accuracy
1	1823	91.2	1845	92.3
-----				
2	1898	94.9	1911	95.6
-----				
3	1838	91.9	1872	93.6

1/ Units evaluated for each procedure: 2,000

Table 14 - Summary of Carcass Evaluation Results by Procedure

<u>Inspection</u>		<u>Units Free of Errors</u>		
<u>Procedure 1/</u>	<u>Type of Error</u>	<u>Total</u>	<u>Percent</u>	<u>CI 95% 2/</u>
Current	Pathological	5559	92.7	92.0-93.4
-----				
New	Pathological	5628	93.8	93.2-94.4

1/ Units evaluated for each procedure: 6,000

2/ Confidence interval: 95 percent

## Analyses

To determine the statistical values of the data collected, the Mathematics and Statistics Division summarized and evaluated the data and performed a statistical analysis (Appendix C).

Summaries of the data are in Tables 11 through 14. Although these summaries show some differences, there is no evidence that a difference exists among the procedures.

To determine the inspection time required to perform the new procedures, the Industrial Engineering and Data Management Division performed a preliminary workload analysis (Appendix D). This analysis shows that, at the test plants, Procedure No. 1 was more productive than the current procedure.

## Note on Results

All dressing or pathological errors detected during evaluation of the current and new procedures were slight, localized, chronic, and did not affect carcass disposition.



## DISCUSSION

### Responsibility

As for the current inspection procedure, plant management has to assure that all viscera are presented for inspection adequately so the inspectors need not perform additional motions to examine them. The eviscerators should present the viscera in the pans properly, such as placing the spleen with the parietal (top) surface exposed and the heart under the lungs' right apical lobe.

To prevent carcass and/or viscera contamination, line stops, and inspectors frequent hand washing, the evisceration procedure should be accomplished without cutting the stomachs or intestines.

The new procedures will not change any of the inspectors' other responsibilities. For example, when a disease condition or a dressing error requires action on the inspectors' part, such as tagging the carcass and viscera, the inspectors will take that action.

### Test Variability

To prevent or reduce variability and bias, the evaluation process was based on the following:

1. The procedures to be tested were randomly selected each day. This selection was not revealed to the evaluators.

2. The evaluators were positioned next to or down the line from the inspection stations so that they were unable to see the inspectors and the procedures being performed. Where necessary, a shield was placed between the inspectors and evaluators at the inspection stations. The evaluators were instructed to examine all units thoroughly and record any errors missed by the inspectors. Also, they were instructed to evaluate and record 100 units and, when one worksheet was completed, to repeat the evaluation and recording for 100 more units; this was done until the required number of units was reached.

3. During the evaluation and recording of each 100 units, the project manager frequently reviewed the presentation, inspection, and evaluation procedures.

4. The procedures were so evaluated that carcasses of animals from the same lots were used.

5. The evaluations were spaced out and alternated during the study.

6. When one worksheet was completed, it was identified with a code of the procedure that had been evaluated.

7. The inspectors rotated assignments and each one had an opportunity to perform the procedures being tested.

8. The evaluators alternated duties so that each one served as evaluator, evaluator/recorder, and evaluator/backup.

## Limitations

The evaluations were conducted at six plants, which were not randomly selected. Any inferences to other plants would be judgmental.

The new inspection procedures were used for about 2 days of familiarization as compared to the ongoing current procedures.

When a unit or part of a unit was retained or condemned, it was assumed that the inspectors noted all lesions for which the unit or part of the unit should have been retained or condemned.

## CONCLUSION AND RECOMMENDATION

The effectiveness and productivity evaluations conducted during this study revealed that the new inspection procedures are as effective as and more productive than the current procedure. As the current procedure, they detect the same diseases and abnormalities, achieve the same inspection quality, and assure the same consumer protection. In addition, Procedure No. 1 and its modified viscera presentation method proved to be the most effective and productive combination for both, inspection and plant operations. This procedure reduces the time required to complete inspection, decreases inspectors' fatigue, and makes inspectors' work easier.

It is recommended that USDA implement Procedure No. 1 in all swine slaughter plants in the United States. This recommendation is based on:

1. The effectiveness of this procedure being equal to that of the current procedure at the tested line speeds as shown in the study.
2. The preliminary workload analysis indicating that this procedure will result in increased productivity without increasing inspection staffing.

It is also recommended that additional work measurement data be collected and a final workload analysis be performed to determine the exact staffing requirements.

As for the traditional presentation methods, plant management should assure that all swine heads, viscera and carcasses are presented for inspection adequately so that the inspectors need not perform additional motions to examine them. As for the current inspection procedure, supervisory inspection personnel should assure that the inspectors perform all tasks of inspection as described in the procedure.



## POST-MORTEM INSPECTION - SWINE

## APPENDIXES

## Appendix A - Use of Worksheet

The worksheets (Appendix B) are designed according to the functions involved and are intended to be used for recording data necessary to evaluate and analyze the effectiveness of current and new swine post-mortem inspection procedures. They are to be used at the evaluation sites immediately after inspection, or as required by the project manager.

Worksheet No. 1 is to be used for viscera evaluation; worksheet No. 2 for kidney evaluation. The worksheets include categories and subcategories. The information recorded should show: (1) tallied units examined, (2) tallied and total units with errors, and (3) total errors.

At the viscera evaluation site, one unit is represented by all abdominal and thoracic viscera. At the carcass evaluation site, one unit is represented by both kidneys, or by one kidney if the other one is missing.

The project manager will determine where and how the units can be selected, notify the veterinary inspector in charge, the inspectors, and plant representatives, and instruct the evaluators when to begin the evaluations.

## Appendix A (continued)

As instructed, the evaluators will examine 100 units for each procedure and use one worksheet for each 100 units. The units will be selected as randomly as possible throughout the day's operation and will include units from carcasses of swine as slaughtered and presented for inspection during the study. To keep track of how many units are evaluated, an evaluator/recorder will tally each unit examined by entering a slash in each of the 100 circles at the bottom of the worksheet.

The numbers 1-15 across the top of the worksheet indicate the units with errors. Enter all errors found on the first unit in Column 1, all errors found on the second unit in Column 2, etc. Enter under pathology, or dressing errors, only those units with errors. If one or more errors are noted in one unit, tally them in the appropriate spaces next to the subcategories and in the same column. If several errors are of the same type, indicate the number in the appropriate space.

For contamination (feces, ingesta, urine, bile) enter an error when it is of sufficient extent that correction would have been called for if it had been recognized at the point of inspection.

The subcategory "Other" is for errors which may not be scored under other subcategories, or to identify an error which may be

## Appendix A (continued)

considered a particular problem. If more than one entry is to be recorded under "Other", identify the unit by circling the number at the top of the worksheet and enter such (circled) number in the "Remarks" space with the type of error(s).

If needed, the "Remarks" space is for clarifying certain tallied errors, or for recording any information pertaining to the evaluation process.

If evaluation of a unit reveals a disease or condition requiring condemnation of the unit, or part of the unit, tally such unit, record the necessary information in the "Remarks" space, and take appropriate action.

If evaluation of a unit reveals a disease or condition requiring the carcass to be re-examined and/or condemned, retain the carcass for "final" examination and disposition by the veterinary inspector in charge, notify the project manager, and enter the necessary information in the "Remarks" space.

Consider both kidneys as one unit. However, tally on worksheets errors found in left kidney in left space and errors found in right kidney in right space of same unit. If one kidney is missing and the other one is free of errors, tally the unit as acceptable.

## Appendix A (continued)

Upon completion of each worksheet, the evaluators will sign in the appropriate spaces and give the worksheet to the project manager who will: (1) identify the procedure evaluated, (2) review all entries, (3) clarify any pathological or dressing errors, if required, (4) compute the raw totals, and (5) initial in the appropriate space.



# Appendix B - Worksheet

WORKSHEET No. 1 SWINE VISCERA INSPECTION		1 EST NO	2 LOCATION (City, State)	3 CHAIN SPEED	4 PROCEDURAL <input type="checkbox"/> Current <input type="checkbox"/> Procedure No. 1 <input type="checkbox"/> Procedure No. 2	5 NO OF INSPECTORS	6a TIME Start Finish	6b DATE																																																																																																														
CATEGORY - SUBCATEGORY	UNITS WITH ERRORS															TOTAL																																																																																																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																																																																																																							
PATHOLOGY	7 Gastrointestinal tract	a. Gastritis, Enteritis																																																																																																																				
	8 Mesenteric nodes	a. Abscess																																																																																																																				
		b. Tuberculous																																																																																																																				
	9 Spleen Lesions (specify)																																																																																																																					
	10 Liver Dorsal Surface	a. Abscess																																																																																																																				
		b. Cirrhosis																																																																																																																				
		c. Other (specify)																																																																																																																				
	11 Liver Ventral Surface	a. Abscess																																																																																																																				
		b. Cirrhosis																																																																																																																				
		c. Other (specify)																																																																																																																				
	12 Portal nodes (specify)																																																																																																																					
	13 Lungs Dorsal Surfaces	a. Abscess																																																																																																																				
		b. Pneumonia																																																																																																																				
		c. Other (specify)																																																																																																																				
	14 Lungs Ventral Surfaces	a. Abscess																																																																																																																				
		b. Pneumonia																																																																																																																				
		c. Other (specify)																																																																																																																				
	15 Bronchial Nodes (specify)																																																																																																																					
	16 Mediastinal Nodes (specify)																																																																																																																					
17 Heart (specify)																																																																																																																						
18 Contamination (pathological)																																																																																																																						
19 Other Pathology (specify)																																																																																																																						
DRESSING ERRORS	20 Contamination (feces, urine, maggots, etc.)																																																																																																																					
	21 Other Dressing Errors (specify)																																																																																																																					
22. UNITS EXAMINED (Tally each unit)																																																																																																																						
<table border="0"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td> </tr> <tr> <td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td><td>32</td><td>33</td><td>34</td> </tr> <tr> <td>35</td><td>36</td><td>37</td><td>38</td><td>39</td><td>40</td><td>41</td><td>42</td><td>43</td><td>44</td><td>45</td><td>46</td><td>47</td><td>48</td><td>49</td><td>50</td><td>51</td> </tr> <tr> <td>52</td><td>53</td><td>54</td><td>55</td><td>56</td><td>57</td><td>58</td><td>59</td><td>60</td><td>61</td><td>62</td><td>63</td><td>64</td><td>65</td><td>66</td><td>67</td><td>68</td> </tr> <tr> <td>69</td><td>70</td><td>71</td><td>72</td><td>73</td><td>74</td><td>75</td><td>76</td><td>77</td><td>78</td><td>79</td><td>80</td><td>81</td><td>82</td><td>83</td><td>84</td><td>85</td> </tr> <tr> <td>86</td><td>87</td><td>88</td><td>89</td><td>90</td><td>91</td><td>92</td><td>93</td><td>94</td><td>95</td><td>96</td><td>97</td><td>98</td><td>99</td><td>100</td><td></td><td></td> </tr> </table>																	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100		
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86	87	88	89	90	91	92	93	94	95	96	97	98	99	100																																																																																																								
23 REMARKS (If additional space is needed, use reverse)																																																																																																																						
24. SIGNATURE(S) OF EVALUATOR(S)																																																																																																																						
25 SIGNATURE OF PROJECT OIC																																																																																																																						

# Appendix B (continued)

WORKSHEET No. 2 SWINE KIDNEY INSPECTION		1. Est. No.	2. Location (City, State)	3. Chainspeed	4. Procedure <input type="checkbox"/> Current <input type="checkbox"/> New	5. No. of Inspectors	6. Date										
CATEGORY - SUBCATEGORY		UNITS WITH ERRORS															TOTAL
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
7. Kidney Conditions	a. Cysts																
	b. Neoplasms																
	c. Abscesses																
	d. Nephritis																
	e. Other (specify)																
8. Units Examined (Tally each unit)																	
1 2 3 4 5		6 7 8 9 10		11 12 13 14 15		16 17 18 19 20		21 22 23 24 25		26 27 28 29 30		31 32 33 34 35		36 37 38 39 40		41 42 43 44 45	
46 47 48 49 50		51 52 53 54 55		56 57 58 59 60		61 62 63 64 65		66 67 68 69 70		71 72 73 74 75		76 77 78 79 80		81 82 83 84 85		86 87 88 89 90	
91 92 93 94 95		96 97 98 99 100		101 102 103 104 105		106 107 108 109 110		111 112 113 114 115		116 117 118 119 120		121 122 123 124 125		126 127 128 129 130		131 132 133 134 135	

9. Remarks (If additional space is needed, use reverse)

Start:  
Finish:

10. Signature(s) of Evaluator(s)			11. Signature of Project OIC
A.	B.	C.	

## Appendix C - Statistical Analysis

The Mathematics and Statistics Division summarized and evaluated all data collected during the inplant evaluations and performed a statistical analysis. During this analysis, estimates of percentages of error-free units, based on the number of errors missed by the inspectors, were computed for the units inspected with the current and new procedures. The percentages computed for one procedure were compared with those computed for the other procedures.

The results for the three procedures tested were summarized in Tables 11 through 14.

A 95 percent confidence interval was calculated for each percent. It is expected that the true number of error-free units for the procedure tested is contained in the 95 percent confidence interval. If the intervals overlap for pathological, dressing and total errors, there is no evidence of a difference among the procedures.

This analysis indicates that all intervals overlap. Therefore, there is no evidence of a difference in error rates among the three procedures.

## Appendix D - Preliminary Workload Analysis

Upon completion of the effectiveness evaluations, work measurement data were collected to determine the time and staffing required to perform the new inspection procedures at different production rates.

Inspectors were work measured while performing the new procedures. This included video taping different inspectors at the evaluation sites. The project manager scheduled the work measurement to be conducted in the plant. He was present during data collection to assure that the inspectors performed the procedures correctly, to recommend the time of data collection, and to arrange for inspectors rotation at the different work stations.

The work measurement data were analyzed to determine the standard times necessary to perform the new procedures. Time in minutes, seconds, and hundredths of a second was superimposed on video taped work measurement data. Task elemental work times necessary to perform inspection elements were calculated.

Elemental work times are the times necessary to perform specific tasks of an inspection procedure. The time required to perform each work element of the new procedures (Tables 3 and 4) was



## Appendix D (continued)

taken from work measurement data collected on videotape and previous work measurement standards. These elemental work times were statistically analyzed and their average was calculated.

Scenes of inspectors performing the inspection tasks were viewed and rated by a panel of trained raters from various Agency programs. The panel's ratings were applied to the average work elemental task times. Difficulty adjustments were added to the time values to allow for additional body, arm or hand movements, or difficult eye-hand coordination. The resulting times were used to calculate the maximum inspection rates with various staffing requirements.

The results of this analysis indicate that the new procedures would increase inspection productivity by 14 to 16 percent. This productivity improvement will be obtained by following the correct presentation methods and by properly performing the required inspection procedure. A specific prediction of the increased productivity cannot be made at this time. After the new procedures have been implemented, additional data will be collected and analyzed to determine the final work measurement standards.





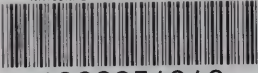


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